**CURRICULUM**

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MA103

# DISCRETE MATHEMATICS

Updated Prot. NO 29/29.6.2023

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## ANNOTATION

The course is designed to provide fundamental training for undergraduate students studying in specialties of the Faculty of Computer Science And Engineering with knowledge of set theory, combinatorics, regular expressions, formal grammars, finite automata, mathematical logic.

## MAIN OBJECTIVES

To acquire new knowledge of set theory, combinatorics, graphs, regular expressions, formal grammars, finite automata, mathematical logic.

Main tasks are related to the formation in students of knowledge and skills in the discipline “Discrete Mathematics” such as:

- Basic mathematical concepts of discrete mathematics such as:
  - Sets;
  - Combinatorics;
  - Boolean functions;
- Formal languages and grammars;
- Finite automata;
- Mathematical logic.

## PREREQUISITES

The discipline is fundamental and requires general knowledge of mathematics from secondary school.

## STATUS AND STRUCTURE

| Specialty | status | ECTS | full-time and distance learning | | | | part-time training | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | C | t | total | L | C | t | total |
| Software Engineering | Mandatory | 7 | 40 | 30 | | 70 | 20 | 20 | | 40 |

## COURSE CONTENT

Theme 1. Sets. Basic concepts and definitions. Operations over sets. Cartesian work.

Theme 2. Relationships and functions. Basic concepts and definitions. Types of Relationships. Functions.

Theme 3. Combinatorics. Basic principles. Dirichlet Principle.

Theme 4. Logical reasoning. Basic concepts. Syntax and Semantics of Deductive Logic.

Theme 5. Logical equivalence of formulas. Equivalent conversions. Normal forms of formulas.

Theme 6. The right reflections. A logical consequence. Natural deduction. Taftologies.

Theme 7. Boolean functions. Basic concepts. Presentation and properties of Boolean functions.

Theme 8. Predicate logic. Basic concepts. Quantori. Syntax and semantics of predicate logic. Logical equivalence of formulas.

Theme 9. Formal languages and grammarc. Basic concepts. Operations over words and formal languages. Hierarchy of Chomsky. Regular expressions.

Theme 10. Finite automata. Presentation. DCA and NCA. Formation of NDCA in DCA. Minimalisation. Finite automata as converters. Millie and Moore's machines.

## SEMINAR EXERCISES

Theme 1. Sets. Presentation and operations over sets. Cartesian work.

Theme 2. Relationships and functions. Types of Relationships. Relation of equivalence. Relations of ordinance. Functions.

Theme 3. Combinatorics. Principles of enumeration combinatorics. Principles of drawers, bisection, breaking, subtraction, etc. Newton's binomial.

Theme 4. Logical reasoning. Syntax and Semantics of Deductive Logic.

Theme 5. Logical equivalence of formulas. Laws of Implication and Equivalence. Equivalent conversions. Normal forms of formulas.

Theme 6. The right reflections. Modus Ponen and Modus Tollens.

Theme 7. Boolean functions. Essential variables. Complete sets.

Theme 8. Predicate logic. Quantifiers for community and existence. TF

Theme 9. Formal languages and grammars. Operations with words and languages. Building formal grammar giving rise to a formal language.

Theme 10. Finite automata. Scheme of work. Construction of NDCA according to set regular grammar. Conversion of NCA into DCA. Minimalisation. Construction of regular grammar according to DCA. Milly and Moore's machines – examples.

## PLANNED LEARNING ACTIVITIES AND TRAINING METHODS

Training activities are two main types - lectures and exercises. Each lecture is presented with a theoretical part and examples.

During exercises, students solve tasks based on the theoretical knowledge gained from the lectures. During lectures and exercises a special focus is put on deepening the concepts and discussing the problems with the active participation of students. The independent and creative thinking of students is stimulated through non-standard assignments.

The recommendations and principles of constructive learning in an interactive educational environment are the fundaments of the implementation of the training in this discipline. The learning process is carried out based on training with an active role of the learner, training through examples, training through practice, training through research and teamwork.

## ASSESSMENT METHODS

Each student's work during the semester is assessed with an ongoing assessment. It is the result of the evaluation of two control works. Each student is also assessed according to their participation in solving tasks during exercises.

The semester exam is oral. The final score is formed as a result of the semester exam, the current evaluation and the tasks solved on the exam.

To form the assessment, the student earns points, the maximum value of which is 100. The allocation of points for the activities under assessment shall be up to:

Ongoing control.....50
2 control works.....40
active participation in the exercises.....10

Examination rocedure.....50
Theoretical questions.....30
Practical tasks.....20

Scoring scale:
up to 50 points — Weak (2);
51 to 60 points — Medium (3);
61 to 70 points — Good (4);
71 to 80 points — Very good (5);
81 to 100 points — Excellent (6).

## RECOMMENDED LITERATURE


1. Denev, J.D., S.V. Shtrakov. Discreet Mathematics, 2005.
2. Denev Y., R. Pavlov, Ya. Demetrich, Discrete Mathematics, Science and Art, Sofia, 1984.
3. It's Manev. K. Introduction to Discrete Mathematics. Ed. NBU, 2013.
4. Petrakieva S., V. Mladenov., Solved examples by discrete structures, "Avangard Prima" Publishing House, fourth edition, Sofia, 2019;
5. Benjamin, A. Discrete Mathematics, Prat 1 and 2, The teaching company, USA, 2012
6. Chen W.W. Discrete Mathematics, Imperial College, University of London, 2015.

7. Rosen K. Discrete Mathematics and Its Application – 7th edition. McGraw-Hill Companies, Inc., 2011.
8. Boycheva S., Toleva-Stoimenova S. Discrete Mathematics – Theoretical Foundations of Informatics – Siela, 2018